

IDENTIFYING NAVIGATION BARS AND OBJECTIONABLE NAVIGATION BARS

§ 1. BACKGROUND OF THE INVENTION

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§ 1.1 FIELD OF THE INVENTION

The present invention concerns reformatting content. In particular, the present invention concerns reformatting content intended to be rendered on a larger display screen (such as typical 15 inch to 21 inch monitors used with personal computers for example), for rendering on a smaller screen. The present invention also concerns identifying navigation bars in general. Such general navigation bar identification may be useful in other applications, such as for purposes of determining whether or not to index text, or whether or not to show text in a snippet search result, for example.

§ 1.2 RELATED ART

The description of art in this section is not, and should not be interpreted to be, an admission that such art is prior art to the present invention. The Internet and traditional modes of Internet access are introduced in § 1.2.1 below. The growth of information access via portable (e.g., wireless) devices having smaller display screens, as well as challenges related to such access and rendering, are then introduced in § 1.2.2 below.

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§ 1.2.1 THE INTERNET AND TRADITIONAL MODES OF INTERNET ACCESS

In recent decades, and starting in the 1990s in particular, computers have become interconnected by networks by an ever increasing extent; initially, via local area networks (or "LANs"), and more recently via LANs, private wide area networks (or "WANs") and the Internet. The proliferation of networks, in conjunction with the increased availability of inexpensive data storage means, has afforded computer users unprecedented access to a wealth of content. Such content may be presented to a user (or "rendered") in the form of text, images, audio, video, etc. Such content is referred to as "documents" or "pages" without loss of generality.

Since the Internet permits many different computers, platforms, and applications to access information, standard "markup languages" have been adopted so that documents retain formatting, indexing, and linking information, without regard to the type of computer, platform, or application supported on the device accessing and rendering the documents. The most common markup languages are briefly introduced below.

Initially, the standard generalized markup language (or "SGML") was adopted by the International Organization for Standardization ("the ISO") in 1986 as a means for providing platform and application independent documents that retain formatting, indexing, and linked information. SGML does so by providing a grammar-like mechanism for users to define the structure of their

documents, as well as tags used to denote the structure in individual documents.

5 The hypertext markup language (or "HTML") is an application of SGML used for documents on the World Wide Web. HTML uses tags to mark elements (such as text and graphics for example) in a document to indicate how Web browsers should display such elements, as well as to indicate how Web browsers should respond to user actions, 10 such as the activation of a link (such as by a mouse click for example).

15 Finally, the extensible markup language (or "XML") is a condensed form of SGML which lets Web developers and designers create customized tags that offer greater flexibility in organizing and presenting information than is possible with HTML.

20 **§ 1.2.2 THE GROWTH OF CONTENT ACCESS VIA, AND
CONTENT RENDERING ON, DEVICES WITH
SMALLER DISPLAY SCREENS**

25 The markup languages introduced above permit Web document authors and designers to format their documents to effectively communicate information to their intended audience. Web document authors and designers often consider many design factors, such as ease of navigation, logical organization, consistency, efficient downloading, etc. The display device on which the intended audience is 30 expected to render such Web documents is a major consideration in the design and authoring of Web sites and Web documents. Traditionally, most access to documents on the World Wide Web has been by means of personal computer,

most of which are equipped with 15 inch to 21 inch
monitors, and many of which support resolutions of
640-by-480 pixels, and beyond. Accordingly, most documents
on the World Wide Web are designed for display on desktop
5 computers with color monitors having at least 640-by-480
resolution.

Internet access and the rendering of Web
documents by devices with smaller displays, such as
10 personal electronic devices, cell phones, mobile phones,
and other portable and/or untethered information access and
communication devices, is rapidly increasing. The wireless
markup language (or "WML") has been introduced to
facilitate authoring documents for rendering on devices
15 with limited display area, limited memory and processing
resources, and lower bandwidth connections.

**§ 1.2.2.1 CHALLENGES RELATED TO REFORMATTING
CONTENT FOR RENDERING ON SMALLER
DISPLAY SCREENS**

The intended audience for many Web sites and Web
documents will often include users accessing and rendering
such Web sites and web documents with traditional desktop
25 computers having larger displays, as well as users
accessing and rendering such Web sites with devices having
smaller displays (as well as users who will use both types
of devices). Such a heterogeneous audience using various
types of devices presents a dilemma for web authors and web
30 designers -- how can different intended audiences, using
different access and/or rendering devices be satisfied?

The article, T. Bickmore et al., "Digestor: Device-independent Access to the World Wide Web," Proc. Of the Sixth World Wide Web Conference, downloaded from <http://decweb.ethz.ch/WWW6/Technical/Paper177/Paper177.html>

5 (hereafter referred to as "the Digestor article", which is expressly incorporated herein by reference), notes that there are four general approaches to displaying Web documents on devices with small display screens: namely, device-specific authoring, multiple-device authoring,
10 client-side navigation, and automated re-authoring.

As their names imply, device-specific authoring and multiple-device authoring involves authoring separate Web documents for specific devices and groups of devices,
15 respectively. Obviously, such approaches require more labor for authoring multiple versions of the same underlying content, require more storage to store such multiple versions of the same underlying content, and require special signaling protocols to determine which
20 device is requesting the Web document.

In the client-side navigation approach, the user can interactively navigate a single web page by altering the portion of it that is displayed at any given time
25 (e.g., by scrolling, zooming, panning, expanding, collapsing, etc.). However, it is believed that such approaches are not well suited for devices with limited memory and processing resources, as well as limited bandwidth access. Further, it is believed that such
30 required user interaction would become annoying to many users.

Automated re-authoring involves transforming an arbitrary Web document, such as a Web document designed for a desktop computer with a typical display device, to a document that can be appropriately displayed on a target display device. This transformation may take place on the client device, on a server, and/or on an intermediate proxy server. Many factors should be considered in designing a satisfactory automated re-authoring tool. For example, it may be desirable for the re-authoring process to treat different individual components of a Web document differently.

It is a goal of the present invention to provide a utility that could be used as a part of a re-authoring process. In this regard, it is a goal of the present invention to detect special components, such as navigation bars and/or objectionable navigation bars for example, of Web documents, so that such components may receive special treatment by a re-authoring process.

§ 2. SUMMARY OF THE INVENTION

The disclosed invention may be used to detect so-called "navigation bars" (or "nav bars"). Generally, a navigation bar can be thought of as text, such as a hyper-text link or anchor text for example, without any immediate content. The present invention may detect navigation bars in a Web document by determining whether or not nodes of a parse tree of the Web document are "anchor-heavy".

Once a navigation bar is detected, the present invention may further be used to distinguish objectionable navigation bars (i.e., navigation bars, the rendering of which would be objectionable to users without special re-authoring), from non-objectionable navigation bars (i.e., navigation bars which would not be objectionable to users with no special re-authoring). Naturally, deciding whether or not the way in which content is rendered would be objectionable to a user is a somewhat subjective endeavor. The present invention may distinguish objectionable navigation bars from non-objectionable navigation bars by: (a) determining whether the navigation bar is so small that normal rendering would not be objectionable; (b) determining whether the navigation bar presumably conveys meaningful content; and/or (c) determining whether the navigation bar is a component of a non-objectionable navigation bar (where all components of the non-objectionable navigation bar are navigation bars themselves).

Various other aspects of the present invention are described below.

§ 3. BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a high-level diagram of an environment in which the present invention may operate.

Figure 2 is a high-level block diagram of an exemplary machine which may be used to effect various processes.

Figure 3 is a flow diagram of an exemplary navigation bar detection/conversion method.

5 Figure 4 illustrates an example of a parse tree which may be generated by the method of Figure 3.

Figure 5 is a flow diagram of an exemplary method for determining whether or not a component of a Web page is an objectionable navigation bar.

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Figures 6A through 6C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in accordance with the present invention, respectively, which
15 illustrate an example of at least some operations of the present invention.

Figures 7A through 7C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in
20 accordance with the present invention, respectively, which illustrate a second example of at least some operations of the present invention.

Figures 8A through 8C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in
25 accordance with the present invention, respectively, which illustrate a third example of at least some operations of
30 the present invention.

Figure 9 illustrates an example of a parse tree corresponding to a table component of a Web document.

§ 4. DETAILED DESCRIPTION

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The present invention involves novel methods, apparatus and data structures for detecting navigation bars, and/or objectionable navigation bars. The following description is presented to enable one skilled in the art to make and use the invention, and is provided in the context of particular applications and their requirements. Various modifications to the disclosed embodiments will be apparent to those skilled in the art, and the general principles set forth below may be applied to other embodiments and applications. Thus, the present invention is not intended to be limited to the embodiments shown and the inventors regard their invention as the following disclosed methods, apparatus and data structures and any other patentable subject matter.

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In the following, an environment in which the present invention may operate is described in § 4.1. Then, functions that may be performed by the present invention are described in § 4.2. Thereafter, exemplary processes, apparatus, methods and data structures that may be used to effect those functions are described in § 4.3. Examples of operations of an exemplary embodiment of the invention are then provided in § 4.4. Finally, some conclusions regarding the present invention are set forth in § 4.5.

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**§ 4.1 ENVIRONMENT IN WHICH THE PRESENT INVENTION
MAY OPERATE**

Various aspects of the present invention may take
5 place in an environment in which a device with a relatively
small display is to render content, such as Web documents
for example, that were designed and authored with the
assumption that they would be rendered on larger display
devices. Figure 1 is a high level block diagram of such an
10 environment 100. As shown in Figure 1, a device 110 with a
relatively small display screen 112 can send search queries
and/or content requests as indicated by communication 140,
and can receive search results and/or content reformatted
for its smaller display 112 as indicated by communication
15 150. The device 110 may be a personal digital assistant, a
portable and/or untethered information access device, a
(wireless application protocol-enabled (or "WAP-enabled"))
cellular phone, a wireless telephone, etc.

20 A search engine 132 may be used to respond to
search queries. An example of such a search engine is that
provided and licensed by Google, Inc. of Mountain View,
California. A content server 134 may provide content, such
as Web documents for example, in response to requests.

25 Much of such content will be authored and formatted with
the assumption that it will be rendered on a normal size
display screen (e.g., 15 inches to 21 inches).

30 A format converter 136 may be used to convert the
format of the content. For example, the format converter
136 may be used to convert content authored and formatted
with the assumption that it will be rendered on a normal

size display screen (e.g., HTML documents), to a format better suited for rendering on a smaller size display screen (e.g., WML documents). An example of such a format converter 136 is a WAP proxy operated by Google, Inc. of Mountain View, CA. The present invention may reside within the format converter 136. Naturally, the format converter 136 may be a part of the content server 134 and/or may be a client-side utility on the device 110. Further, the various operations of the format converter 136 may be performed at various facilities (e.g., server, proxy, client device, etc.). The present invention may be used as a part of a format converter 136 as described in § 4.3.1 below. Basically, the format converter 136 may include an automated re-authoring process 137. This process 137 may include a navigation bar detection process 138 and an objectionable navigation bar detection process 139 (which may operate on the results of the navigation bar detection process 138).

The search engine 132, the content server 134, and/or the format converter 136 may be located on or at the same facility 130, or may be separately provided. In any event, the device 110 can communicate with each of these components 132,134,136 via one or more networks 120, such as the Internet for example.

Having described an environment in which the present invention may operate, functions that may be performed by the present invention are now introduced in § 4.2 below. The foregoing exemplary environment illustrates but one application to which the teachings of the present invention may be applied. The teachings of the

present invention have other applications. For example, as noted in § 1.1 above, navigation bar detection may be used for determining whether or not to index text, and whether or not to show text in a snippet search result.

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**§ 4.2 FUNCTIONS THAT MAY BE PERFORMED BY THE
PRESENT INVENTION**

10 The present invention may function to detect navigation bars. Generally, a navigation bar can be thought of as text, such as a hyper-text link or anchor text for example, without any immediate content. The present invention may function to detect navigation bars in a Web document by determining whether or not nodes of a
15 parse tree (which correspond to document components) of the Web document are "anchor-heavy".

20 Once a navigation bar is detected, in some exemplary embodiments, the present invention may further function to distinguish objectionable navigation bars (i.e., navigation bars, the rendering of which would be objectionable to users without special re-authoring), from non-objectionable navigation bars (i.e., navigation bars which would not be objectionable to users with no special
25 re-authoring). Naturally, deciding whether or not the way in which content is rendered would be objectionable to a user is a somewhat subjective endeavor. The present invention may distinguish objectionable navigation bars from non-objectionable navigation bars by: (a) determining
30 whether the navigation bar is so small that normal rendering would not be objectionable; (b) determining whether the navigation bar presumably conveys meaningful

content; and/or (c) determining whether the navigation bar is a component of a non-objectionable navigation bar (where all components of the non-objectionable navigation bar are navigation bars themselves).

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Having introduced various functions which may be performed by the present invention, exemplary processes, architecture, methods and data structures that may be used to perform at least some of those functions are described in § 4.3 below.

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§ 4.3 EXEMPLARY PROCESSES, ARCHITECTURE, METHODS AND DATA STRUCTURES

In the following, processes that may be performed by the present invention are introduced in § 4.3.1 below. Then, architecture, methods and data structures that may be used to effect these processes are described in § 4.3.2.

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§ 4.3.1 PROCESSES

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Referring back to Figure 1, a format converter 136 may effect an automated re-authoring process 137. Such an automated re-authoring process 137 may include a navigation bar detection process 138 and an objectionable navigation bar detection process 139. The present invention may perform these processes 138,139.

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§ 4.3.2 EXEMPLARY EMBODIMENT(S)

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Exemplary systems on which the navigation bar detection process 138 and/or the objectionable navigation

bar detection process 139 may be effected are described in
 § 4.3.2.1 below. Then exemplary data structures that may
 be used by these processes, as well as exemplary methods
 that may be used to effect these processes are described in
 5 § 4.3.2.2 below.

§ 4.3.2.1 EXEMPLARY ARCHITECTURES

Figure 2 is high-level block diagram of a machine
 10 200 that may effect one or more of the processes discussed
 above. The machine 200 basically includes a processor(s)
 210, an input/output interface unit(s) 230, a storage
 device(s) 220, and a system bus(es) and/or a network(s) 240
 for facilitating the communication of information among the
 15 coupled elements. An input device(s) 232 and an output
 device(s) 234 may be coupled with the input/output
 interface(s) 230.

The machine 200 may be a computer such as a
 20 personal computer for example. In such an embodiment, the
 processor(s) 210 may be a microprocessor, the storage
 device(s) 220 may include RAM, ROM, magnetic, optical,
 and/or magneto-optical (disk) storage facilities, the input
 device(s) 232 and interfaces 230 may include a keyboard,
 25 various ports, a communication port, network terminal
 adapters, etc., and the output device(s) 234 and interfaces
 230 may include a video display device, a speaker(s),
 various ports, etc.

30 The processes 138/139 may be effected by the
 machine 200 by having the processor(s) 210 execute
 machine-executable instructions which may be stored on a

storage device(s) 220 and/or received via an input device 232, an input interface 230 and the system bus or network 240.

Having described processes that may be performed by the present invention, as well as an exemplary device that may be used to effect such processes, exemplary methods and data structures that may be used to perform such processes are described in § 4.3.2.2 below.

§ 4.3.2.2 EXEMPLARY METHODS AND DATA STRUCTURES

Figure 3 is a high-level flow diagram of an exemplary method 138' that may be used to detect and/or convert navigation bars (e.g., found in HTML Web documents). As indicated by block 305, content (e.g., an HTML document) formatted for rendering on a large size display screen (e.g., 15 inches to 21 inches) is accepted. Then, as indicated by block 310, a parsed tree corresponding to the content is generated. The generation of parse trees is well-known. (See, e.g., the text Aho et al., "Compilers - Principles, Techniques and Tools", Addison-Wesley Publishing Co., (1985).) An exemplary parse tree is now described with reference to Figure 4.

Basically, a parse tree is a hierarchical representation of a segment of a document (e.g., an HTML page) based on inclusive relationships between components. That is, if component A is "included in" component B, then a node A will be a child (or more generally, a descendant)

of a node B in the parse tree. For example, the following HTML document segment:

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5      <p>
      This is a <a href="http://foobar.com">link</a>.
      <ul>
          <li> foo!sample.
          <li> list item.
      </ul>
10     </p>

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Can be represented by the parse tree 400 of Figure 4.

As shown in Figure 4, the parse tree 400 includes hierarchical levels 410, 420, 430, 440, and 450. The top-level 410 includes a paragraph node 412. This node 412 corresponds to the first line of the foregoing HTML segment. As indicated in level 420, a phrase 422, an anchor 424, another phrase 426 and a list 428 are included in the paragraph 412. Nodes 422, 424, and 426 correspond to the second line, and node 428 corresponds to the third line, of the foregoing HTML segment. As indicated in level 430, a number of terms are included in the phrase node 422, a phrase 432 is included in the anchor node 424, a punctuation is included in the phrase node 426, and two list elements 434, 436 are included in the list node 428. These list element nodes 434, 436 correspond to the fourth and fifth lines of the foregoing HTML segment. As indicated in level 440, a term 442 is included in the phrase node 432, phrases 444 and 446 are included in list element node 434, and phrase 448 is included in list

element 436. Finally, as indicated in level 450, terms and punctuations are included in the phrases 444, 446 and 448.

Referring back to Figure 3, as indicated by loop 5 315-335, certain properties of each node of the parse tree are determined. For example, as indicated by block 320, the sum of all "anchors" (and, in one embodiment, the sum of all "anchor words") of (a document component corresponding to) a given node and all of its descendents 10 may be determined. Anchors may be text defining a (e.g., hypertext) link. An example of an anchor is text that occurs inside an HREF line in HTML, or between <a> and tags in HTML. Anchor words may be the number of words in the anchor (or link). As indicated by block 325, the sum 15 of all words of (a document component corresponding to) a given node and all of its descendents may be determined. Finally, as indicated by block 330, the sum of all non-anchor words of (a document component corresponding to) the given node and all of its descendents are determined. 20 In the alternative embodiment in which the sum of all "anchor words" was already determined in block 320, these values may be determined based on the previous two determinations (i.e., sum of all words less sum of all anchor words yields sum of all non-anchor words). To 25 reiterate, as indicated by loop 315-335, each node of the parse tree may be processed as described above.

As indicated by loop 340-360, each of the nodes may be checked to determine whether or not it corresponds 30 to an objectionable navigation bar. Block 345 indicates this determination. As indicated by conditional branch point 350 and block 355, if the node is an objectionable

navigation bar, then the node is so identified and/or special reformatting is applied as a part of a re-authoring process. After all nodes are processed, the method 138' is left via RETURN node 365. As will become apparent from the description of Figure 5 below, in some instances, certain nodes may be disqualified ahead of time from being an objectionable navigation bar.

Although the method 138' was described as including two loops through each of the nodes, the nodes of the parsed tree can be processed in alternative ways (e.g., breadth first, depth first, etc.). Further, the processing can be done in real time, in response to a request for content, in its entirety. Alternatively, at least some, if not all, of the steps of the method 138' can be pre-computed, before a request for content is received. A post order (e.g., bottom-up) traversal of the parse tree is a preferred way of performing acts 320, 325 and 330.

Recall from the process 139 of Figure 1 and step 345 of Figure 3 that whether or not a node corresponds to an objectionable navigation bar may be determined. Figure 5 is a high level flow diagram of an exemplary method 139'/345' that may be used to make such a determination. Initially, whether or not a given node corresponds to a navigation bar in general (without regard to whether or not it is objectionable) may be determined as indicated by conditional branch point 510. If the node does not correspond to a navigation bar, the method 139'/345' is left via RETURN node 570. If, on the other hand, it is determined that the node corresponds to a navigation bar, further acts may be used to determine whether or not the

navigation bar is objectionable, and the method 139'/345' branches to conditional branch point 520. Although shown differently in the embodiment shown, the navigation bar may be presumed to be objectionable, but can be disqualified
 5 from being considered objectionable.

Referring back to conditional branch point 510, whether or not a node is a navigation bar may be determined as follows. Recall that, generally speaking, a navigation
 10 bar can be thought of as text, such as a hyper-text link or anchor text for example, without any immediate content. To reiterate, this determination may be somewhat subjective. The following exemplary heuristic may be use to automate this determination. A node is considered to be a
 15 navigation bar if it is "anchor-heavy". To reiterate, anchors may be text defining a (e.g., hypertext) link, such as text that occurs inside an HREF line in HTML for example. Whether or not (a node corresponding to) a component is "anchor-heavy" will be based on the number of
 20 anchors versus the amount of non-anchor text (e.g., the number of non-anchor words) within the component. In the exemplary heuristic, a node is considered to be "anchor-heavy" if it contains more than a predetermined number of anchors (> min_anchors, where min_anchors may be
 25 three or about three for example) and has more anchors (Recall block 320 of Figure 3.) than non-anchor words (Recall block 330 of Figure 3.).

In one embodiment, if a particular anchor has
 30 more than a predetermined number of words (> max_words_in_anchor_word, where max_words_in_anchor_word may be four or about four for example), those words are

treated as non-anchor words in the forgoing determination. The rationale for this alternative adjustment is that an anchor with a relatively large number of words can be assumed to convey meaningful content (which is contrary to the definition of a navigation bar relevant to the exemplary embodiment of the invention).

Other heuristics for determining whether or not (a node corresponding to) a component is anchor-heavy may be used. For example, such (a node corresponding to) a component may be considered to be anchor-heavy if the number of anchors (or, alternatively, the number of anchor words) is greater than the amount of non-anchor text (e.g., the number of non-anchor words) in the component, or, in an alternative heuristic, whether or not the ratio of anchors (or, alternatively, anchor words) to non-anchor text (e.g., the number of non-anchor words) is greater than a predetermined value (e.g., one).

Resuming at conditional branch point 520 of Figure 5, it may be determined whether the navigation bar is very small. For example, a navigation bar may be considered very small if its corresponding node has less than a predetermined number of anchors (= min_anchors, where min_anchors may be three or about three for example). The rationale for this test is that even if a part of a Web document corresponds to a navigation bar, if it doesn't occupy much space, it won't be objectionable since it won't occupy much space even on a smaller display screen. If the navigation bar is found to be very small, the method 139'/345 branches to block 560 where the node is identified as being disqualified from being an objectionable

navigation bar. The results of this act 560 may be used in later determinations. (See, e.g., conditional branch point 540.) If, however, such results are not required, the act 560 need not be performed. Referring back to conditional
5 branch point 520, if the navigation bar is not found to be very small, the method 139'/345' may branch to conditional branch point 530.

At conditional branch point 530, it may be
10 determined whether the navigation bar conveys any meaningful content. (This is similar to the alternative adjustment described above with reference to decision branch point 510.) For example, a navigation bar may be considered to convey meaningful content if it occupies at
15 least a predetermined amount of the Web document. Whether or not a navigation bar occupies at least a predetermined amount of the Web document may be determined spatially and geometrically, based on the format of the Web document. However, a words ratio criteria may be used as a simple
20 approximation of such a more complicated special/geometric test. For example, a navigation bar may be considered to convey meaningful content if the number of words associated with the node (and its descendents) divided by the total number associated with words in the Web document is greater
25 than a predetermined threshold ($> \text{max_r_words_}\%$, where max_r_words may be in a range from about 33% to about 50%), then it can be assumed that the navigation bar associated with the node conveys meaningful content. If the navigation bar is assumed to convey meaningful content, in
30 view of the words ratio test for example, the method 139'/345' branches to block 560 where the node is identified as being disqualified from being an

objectionable navigation bar. Referring back to conditional branch point 530, if the navigation bar is not assumed to convey meaningful content, the method 139'/345' may branch to conditional branch point 540.

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At conditional branch point 540, it is determined whether any ancestor node of the given node was determined to be a navigation bar, has only navigation bar descendants, and was disqualified from being an objectionable navigation bar (Recall, e.g., step 560). If so, the given node is disqualified as an objectionable navigation bar as indicated by block 560. Note that the condition that the disqualified ancestor node has only navigation bar descendants implies that only a continuous chain of "navigation bar" nodes is considered. Therefore, processing could start at a given node, moving up one ancestor at a time, and quitting if and when an ancestor that is not a navigation bar (e.g., is not anchor-heavy) is reached. In one embodiment of this test, the ancestor node must have been disqualified based on a relative size test, such as the one just described above with reference to conditional branch point 530.

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The rationale for this test is that if a node is a navigation bar that is a component or part of a larger navigation bar that includes only other navigation bars, if that larger navigation bar is disqualified as an objectionable navigation bar, its individual components, all of which are navigation bars, will not be permitted to be qualified as an objectionable navigation bar. Figures 8A and 9 illustrate an application of this test to an exemplary Web document having a table. As shown in Figure

9, the document may include a table represented by node
 910, the table node 910 may include a number of row nodes
 922, 924 corresponding to rows, each row node 922, 924 may
 include a number of cell nodes 932, 934 corresponding to
 5 cells, each of the cell nodes 932, 934 may include nodes
 corresponding to anchors, each of the anchor nodes 940
 (only one shown to simplify the drawing) may include nodes
 corresponding to phrases, and each of the phrase nodes 950
 (only one shown to simplify the drawing) may include nodes
 10 corresponding to terms and/or punctuation. Now assume that
 the table component is a navigation bar, each of the rows
 is a navigation bar, and each of the cells is a navigation
 bar. Assume further that the table node 910 is
 disqualified from being classified as an objectionable
 15 navigation bar because the number of its (and its
 descendants) words is greater than a predetermined
 percentage (e.g., 33%) of the total number of words in the
 Web document. As a consequence of the test associated with
 conditional branch point 540, the column nodes 922 and 924
 20 are also disqualified from being classified as an
 objectionable navigation bar because, in each case, its
 ancestor (i.e., node 910) was disqualified and has only
 navigation bar nodes as children. Similarly, the cell
 nodes 932, 934 are also disqualified, and so on.

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Now, referring back to the conditional branch
 point 540, if, on the other hand, the test is not met, the
 node is identified as an objectionable navigation bar as
 indicated by step 550, before the method 139'/345' is left
 30 via RETURN node 570. Notice that the determination of
 conditional branch point 540 requires characteristics about
 a node's ancestor nodes. Thus, in one embodiment of the

invention, ancestor nodes may be processed before their descendants.

Note that the conditional branch points 520, 530, 540 may be processed in any order, and that not all of these tests are strictly necessary.

§ 4.4 EXAMPLES OF OPERATIONS IN AN EXEMPLARY EMBODIMENT

This section provides three examples which illustrate operations of an exemplary embodiment of the present invention. The SF (San Francisco) Gate Traffic HTML page display, as well as its WML display pages without and with the present invention are illustrated in § 4.4.1 below with reference to Figures 6A through 6C. The Microsoft Network (MSN) Love & Relationships HTML page display, as well as its WML display pages without and with the present invention are illustrated in § 4.4.2 below with reference to Figures 7A through 7C. Finally, the Open Directory Project HTML page display, as well as its WML display pages without and with the present invention are illustrated in § 4.4.3 below with reference to Figures 8A through 8C.

§ 4.4.1 SAN FRANCISCO GATE TRAFFIC PAGE EXAMPLE

Figures 6A through 6C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in accordance with the present invention, respectively, which

illustrate an example of at least some operations of the present invention.

As shown in Figure 6A, a number of navigation bars 610a through 650a appear in the left column of the SF Gate Traffic HTML page. As shown in Figure 6B, without the present invention, these navigation bars would be presented in full, as denoted by labels 610b through 650b. Finally, as shown in Figure 6C, an exemplary embodiment of the present invention may determine that these navigation bars are part of a component which may be considered an objectionable navigation bar. That is, the left column of hyper-text links is anchor-heavy, is not very small, does not occupy at least a predetermined amount (e.g., 33 percent) of the screen, and is not a descendant of a navigation bar that was disqualified from being classified as an objectionable navigation bar and that only has navigation bars as its children. As shown in Figure 6C, the objectionable navigation bar, including navigation bars 610 through 650, is provided in one line 610c-650c as a hyper-text link to the individual navigation bars. Notice that the present invention frees space for other information.

§ 4.4.2 MSN LOVE & RELATIONSHIPS PAGE EXAMPLE

Figures 7A through 7C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in accordance with the present invention, respectively, which illustrate a second example of at least some operations of the present invention.

As shown in Figure 7A, a number of navigation bars 710a through 740a (actually, component 730a is not considered a navigation bar, as will be explained below) appear across the top and in the left column of the MSN Love & Relationships HTML page. As shown in Figure 7B, without the present invention, these navigation bars would be presented in full, as denoted by labels 710b through 740b. Finally, as shown in Figure 7C, an exemplary embodiment of the present invention may determine that some of these navigation bars are objectionable navigation bars. That is, each of the navigation bars 710a, 720a, and 740a is not very small, does not occupy at least a predetermined amount (e.g., 33 percent) of the screen, and is not a descendant of a navigation bar that was disqualified from being classified as an objectionable navigation bar and that has only navigation bars as its children. However, since the hyper-text link "More communities . . ." has more than a predetermined number of words (e.g., four), the non-anchor word count is incremented. Thus, the navigation bar 730a is not deemed objectionable. Indeed, since the component 730a is not anchor-heavy in accordance with one exemplary embodiment of the present invention, it is not even considered to be a navigation bar. This is because it is presumed (by virtue of its word count) that this component has immediate context. As shown in Figure 7C, each of the objectionable navigation bars, 710a, 720a and 740a, are provided in a single line 710c, 720c and 740c, respectively as a hyper-text link to the individual navigation bars. Notice, however, that since component 730a was disqualified from being classified as an objectionable navigation bar (or more specifically, was not

found to be a navigation bar), it is rendered over multiple lines 730c, in the same manner as 730b.

§ 4.4.3 OPEN DIRECTORY PROJECT PAGE EXAMPLE

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Figures 8A through 8C are a screen shot of an HTML formatted Web document, a WML formatted Web document, and a WML formatted Web document as reformatted in accordance with the present invention, respectively, which illustrate a third example of at least some operations of the present invention.

As shown in Figure 8A, navigation bars 810a and 820a appear across the top and in the center, respectively, of the "ODP" HTML page. As shown in Figure 8B, without the present invention, these navigation bars would be presented in full, as denoted by labels 810b and 820b. Finally, as shown in Figure 8C, an exemplary embodiment of the present invention may determine that one of these navigation bars is an objectionable navigation bars. That is, navigation bar 810a is not very small, does not occupy at least a predetermined amount (e.g., 33 percent) of the screen, and is not a descendant of a navigation bar that was disqualified from being classified as an objectionable navigation bar and that has only navigation bars as its children. On the other hand, since the navigation bar 820a takes up more than a predetermined amount (e.g., 33 percent) of the screen, it is disqualified from being deemed objectionable. Further, although each of the column and cell components of the table 820a may be navigation bars, since each is a descendant of a disqualified navigation bar (i.e., the table) and since that table has

only navigation bar components, each of the column and cell components of the table 820a are disqualified from being classified as an objectionable navigation bar. As shown in Figure 8C, the objectionable navigation bar 810a is

provided in a single line 810c as a hyper-text link to the links in the navigation bar. Notice, however, that since component 820a was disqualified from being classified as an objectionable navigation bar, it is rendered over multiple lines 820c, in the same manner as 820b.

§ 4.5 CONCLUSIONS

As can be appreciated from the foregoing disclosure, the present invention discloses various techniques for detecting navigation bars in general, and objectionable navigation bars in particular, in documents (e.g., HTML) designed with the assumption that they will be rendered on larger display screens (e.g., 15 inch to 21 inch). Being able to detect objectionable navigation bars allows an automated re-authoring process to generate more meaningful and intuitively navigable pages (e.g., WML) formatted for smaller screens (e.g., those on portable devices, such as mobile telephones).